The Spokesman

OFFICIAL
PUBLICATION

NATIONAL LUBRICATING GREASE INST NLGI

How *Precision Streamliner Laboratory Water Stills

GIVE PURER DISTILLATE

Make Your Work Easier . . . Cut Costs

NEW! Exteriors All Stainless Steel

- Skilfully simple design permits 10-second take-down, easiest cleaning
- Pre-heated constant-level raw water saves heat and watching
- Vapor Seal eliminates troublesome gaskets, speeds cleaning
- Oversize vapor-flue avoids foaming, carry-over of solids, hard water-problem.
- Vapor spreader and maze slows flow, "scrubs out" *all* impurities
- Vast, open condenser gives maximum surface, minimum cleaning
- Heavy block tin prevents metallic contamination, wears longer
- Special vent carries off volatiles at top of vapor-rise
- Insulated evaporator speeds output, cuts heat cost
- "Crafted" construction gives far longer worry-free service, neatness
- Wide selection—steam, gas, electric; 1 to 4 gallons per hour—suits any need

Many of these features are *Precision *exclusives*—yet you pay no more for this *certain* satisfaction. Order from your supplier now . . . or write us for Bulletin 3-910

Precision Scientific Company

The FINEST Research & Production Control Apparatus
3737 W. Cortland Street, Chicago 47
OFFICES IN NEW YORK • PHILADELPHIA • SAN FRANCISCO

WITCO
technical service
...available to help solve your technical problems

Witco has recently appointed Dr. E. F. Wagner to head its Technical Service Department.

The main Technical Service Laboratory is located in Chicago where a staff of trained chemists and technicians is constantly working on customers' problems.

One group devotes itself solely to problems in connection with the use of metallic stearates . . . another group is busily engaged in solving problems in connection with driers . . . while a third handles miscellaneous problems concerned with other products manufactured by Witco.

A. B. Craig, Jr. is the Eastern Technical Service representative with headquarters in the New York office.

All of Witco's Technical Service facilities are at your service at all times to assist in solving your problems.

YOU KNOW THAT WITCO MAKES HIGHEST QUALITY PRODUCTS

Send for samples and technical service reports on WITCO's grease grade stearates

ALUMINUM STEARATE 22-G
ALUMINUM STEARATE 22-C
ALUMINUM STEARATE 23
ALUMINUM STEARATE 22
LITHIUM STEARATE

WITCO
Chemical Company

295 Madison Ave., N. Y. 17, N. Y.

Los Angeles • Boston • Chicago • Detroit
Cleveland • San Francisco • Akron
London and Manchester, England

AERO* BRAND STEARATES

meet your strictest requirements because

QUALITY IS ASSURED

by our modern plant using up-to-the-minute production facilities

UNIFORMITY IS ASSURED

by a new process under continuous chemical control from raw materials to packaging

ECONOMY IS ASSURED

by special packaging in multi-wall paper bags that save in shipping, handling, storage space

Write for full information on Aero Brand Stearates

AMERICAN Cyanamid COMPANY

INDUSTRIAL CHEMICALS DIVISION

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

*Trademark

LUBREX 45

has ideal melting point for greases and harder soaps

44.0-46.0°C

LUBREX 45

TITRE....(111.2-114.8°F)

Color 5¼" Lovibond Column (max.)	35 Yellow—8 Red		
Iodine Value (Wijs)	25	—	35
Free Fatty Acid (as oleic)	100	—	104%
Acid Number	199	—	206
Saponification Value	202	—	209

RED OIL
GLYCERINE
STEARIC ACID
WHITE OLEINE
HYDROGENATED FATTY ACIDS
STEARINE PITCH
ANIMAL AND VEGETABLE FATTY ACIDS
PALMITIC ACID

Lubrex 45, a product of Hardesty research, fits the demand for a polyunsaturate-free fatty acid especially designed for soap and lubricating grease manufacture. The fatty acids in Lubrex 45 are stabilized in our new hydrogenation unit, to give them a greater resistance to heat discoloration. Freedom from polyunsaturated fatty acids prevents rancidity or gum formation from excess unsaturation. No highly unsaturated acids remain to act as agents for polymerization. The melting point of Lubrex 45 has been accurately controlled to give the optimum possible degree of hardness for your precise requirements. Color and uniformity are strictly maintained. Write for details.

W. C. HARDESTY CO., INC.

HARDESTY PRODUCTS ARE INDUSTRY'S KEYSTONE

41 EAST 42nd STREET, NEW YORK 17, N. Y.

FACTORIES: DOVER, OHIO—LOS ANGELES, CALIF.—TORONTO, CAN.

When Lubricants must "Carry the Load"

Metasap Stearates assure top performance

When bearings, gears and other moving parts are called upon to give service plus—perform efficiently at full rated capacity hour after hour—that is when lubricants made from Metasap Stearates pay off! When machinery must keep on the job in spite of heavy punishment day in and day out—must "buck" the damaging effects of bad weather and difficult terrain successfully—that is when lubricants based on Metasap Stearates prove tops!

For lubricants based on Metasap Stearates are moisture-proof, temperature-resistant, water repellent . . . do not bleed, cake, freeze, evaporate or dissolve. Highly stable, they do a thorough lubricating job however tough the operating conditions.

Learn all about them from your nearest Metasap representative . . . our Technical Service is nation-wide, and ready at all times to handle inquiries promptly. Or send your specifications directly to us. We shall be glad to make recommendations based upon your particular needs.

And don't forget to ask for our free booklet: "Metallic Soaps for Research and Industry." You will find it full of helpful information.

METASAP CHEMICAL COMPANY
Harrison, New Jersey

Chicago • Boston • Richmond, Calif. • Cedartown, Ga.
Stocks at: Cleveland, Ohio; Louisville, Ky.; San Francisco and Los Angeles, Cal., Portland, Ore.; Spokane and Seattle, Wash.

METASAP CHEMICAL COMPANY
REG. U.S. PAT. OFF.

Stearates

of Calcium • Aluminum • Lead • Magnesium • Zinc

SHIPPING CONTAINERS—*to be sure*

BUT YOU GET MORE THAN JUST THAT!

G. P. & F. E-Z-FILL GREASE GUN LOADER CONTAINER

G. P. & F. DOME TOP UTILITY CAN

These G. P. & F. specialty containers are a sales-minded twosome for your oils and greases. They are built to be safe and dependable shipping packages . . . but they will do more than just that. They offer a premium value to your customers—extras that will actually help you sell your products!

E-Z-FILL PAIL

When it comes to filling grease guns the E-Z-FILL pail is a specialist. It brings grease to your customers in a package that is easy and convenient to use.

Grease is drawn directly into the gun without removing the cover of the pail.

IT'S CLEAN—No messy handling involved. The grease never touches anything except the inside of the pail and the inside of the gun.

IT'S FAST—Just screw the gun into the socket, draw out the plunger and remove the gun.

IT'S ECONOMICAL—There is no waste. The grease is never exposed. Dirt, grit and moisture can't get into it.

25 AND 35 POUND SIZES.

DOME TOP UTILITY CAN

There is no handier container you can give to your customers. Has dozens of utility uses after it is empty. It's not a throw-away item, but a premium that will keep your name before the user.

Sturdily constructed from 26 or 28 gauge steel . . . Dome has strong reinforcing ribs . . . Body has big, flat surface for silk screening, labels or lithographed design . . . Short pouring spout adds strength and saves carton space . . . Riveted bail has plenty of "knuckle clearance" over the filler cap.

5 GALLON AND 40 POUND SIZES.

Write today for sample containers. We'll be glad to send them to you.

G. P. & F. also manufactures a complete line of small steel pails and drums—
1½ to 6½ gallons—22 to 29 gauge steel.

G.P.&F. STEEL CONTAINERS MILWAUKEE

GEUDER, PAESCHKE & FREY CO.

300 NORTH 15TH STREET • MILWAUKEE 3, WISCONSIN

Officers

President: A. J. DANIEL, Battenfeld Grease and Oil Corporation, 3148 Roanoke Road, Kansas City 8, Missouri.

Vice-President: HOWARD COOPER, Sinclair Refining Company, 630 Fifth Avenue, New York, New York.

Treasurer: E. V. MONCRIEFF, Swan-Finch Oil Company, Rm. 1605, R. C. A. Building, New York 20, N. Y.

Executive Secretary: HARRY F. BENNETTS, 4638 Mill Creek Parkway, Kansas City 2, Missouri.

Directors

W. W. ALBRIGHT, Standard Oil Company of Indiana, 910 S. Michigan, Chicago, Ill.

M. R. BOWER, Standard Oil Co. of Ohio, Midland Building, Cleveland 15, Ohio.

HOWARD COOPER, Sinclair Refining Company, 630 Fifth Ave., New York, N. Y.

J. R. CORBETT, Cato Oil and Grease Company, 1808 East Ninth St., P. O. 172, Oklahoma City, Oklahoma.

R. CUBICCIOTTI, L. Sonneborn Sons, Inc., 300 Fourth Avenue, New York, New York.

A. J. DANIEL, Battenfeld Grease and Oil Corp., 3148 Roanoke Rd., Kansas City, Mo.

H. L. HEMMINGWAY, The Pure Oil Company, 35 E. Wacker Drive, Chicago, Ill.

H. P. HOBART, Gulf Oil Company, Gulf Building, Pittsburgh, Pa.

C. B. KARNS, Esso Standard Oil Co., 34th and Smallman, Pittsburgh, Pa.

PAUL V. KEYSER, JR. Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.

H. A. MAYOR, Southwest Grease and Oil Co., 220 West Waterman, Wichita, Kans.

L. W. McLENNAN, Union Oil Company of California, Oleum Refinery, Oleum, California.

G. E. MERKLE, Fiske Bros. Refining Company, 129 Lockwood Ave., Newark 5, N. J.

E. V. MONCRIEFF, Swan-Fitch Oil Company, Rm. 1605, R.C.A. Building, New York 20, New York.

W. H. OLDACRE, D. A. Stuart Oil Co., Ltd., 2727 South Troy, Chicago 23, Illinois.

F. E. ROSENSTIEHL, The Texas Company, 135 East 42nd St., New York 20, N. Y.

W. H. SAUNDERS, JR., International Lubricant, Corp., New Orleans, Louisiana.

B. G. SYMON, Shell Oil Company, Inc., 50 West 50th, New York 20, N. Y.

The INSTITUTE SPOKESMAN

Published monthly by

THE NATIONAL LUBRICATING GREASE INSTITUTE
4638 Mill Creek Parkway, Kansas City 2, Mo.

HARRY F. BENNETTS, *Editor* BEVERLY KENNETT, *Associate Editor*

1 Year Subscription ..... $2.00 1 Year Subscription (Foreign) ... $2.75

In This Issue March, 1950

Volume XIII Number 12

Basic Factors Determining the Structure and Rheology of Lubricating Greases . . . . . **Page 12**
by A. Bondi, A. M. Cravath, R. J. Moore and W. H. Peterson
Shell Development Company

Greasonalities . . . . . **Page 20**

Index, April 1949 through March 1950 . . . . . **Page 10**

Patents and Developments . . . . . **Page 21**

Technical Committee Column . . . . . **Page 21**
by T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

President's Page . . . . . **Page 9**
by A. J. Daniel, Battenfeld Grease and Oil Corporation

The NATIONAL LUBRICATING GREASE INSTITUTE assumes no responsibility for the statements and opinions advanced by contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of the NATIONAL LUBRICATING GREASE INSTITUTE. Published monthly by the NATIONAL LUBRICATING GREASE INSTITUTE from 4638 Mill Creek Parkway, Kansas City 2, Missouri. Copyright 1950, The National Lubricating Grease Institute.

ABOUT THE COVER

In cooperation with the Fafnir Bearing Company, Precision Scientific Company is making available an apparatus for testing lubricants suitable for lubricating bearings undergoing oscillating or vibratory movement. Bearing damage has occurred in many antifriction bearings that are normally at rest, and oscillate through small angles in applications; such as, automobile spring shackles, king pins, aircraft rocker arms, variable pitch propellers, landing wheels, transported machinery and motors, textile cam followers, etc.

For a full discussion of factors involved and test procedures adopted read "Friction Oxidation" by Hudson T. Morton and Francis G. Patterson, which appeared in the August 1948 issue of the Institute Spokesman.

This instrument gives a true evaluation of greases intended to be used on thrust bearings. Grease manufacturers, the petroleum industries, and large users of grease makers or chemical additives, will find ready application for the Precision-Fafnir Oscillating Grease Tester.

In operation, the test grease is applied to a washed and weighed test pair of thrust bearings. The proper load is applied with a simple lever which exerts thrust through a calibrated spring. An electric motor is started to oscillate the test bearing through an angle of 6°, at a rate of 3400 reversals per minute under a thrust load of 550 lbs. The test is run continuously for fifty hours, and at the end of that time the bearings are washed and weighed again. The loss in weight indicates the suitability of the lubricant under oscillating conditions. The factors of grease consistency, adhesive quality, oxidation resistance and acidic deterioration are all, or can be, influential in bearing wear.

The Precision-Fafnir Grease Tester duplicates field conditions, and will give positive indication of the suitability of grease and additives when used to lubricate bearings subject to small angle vibratory movement.

(*Continued on page 25*)

President's page

by Arthur J. Daniel, President, N.L.G.I.

Is it possible to do a job too well? This question comes to my mind everytime I drive down a highway, read a newspaper, or listen to the radio. For every where we turn we are faced with bill boards, advertisements, and radio commercials proclaiming the merits of motor oil lubrication. True . . . most of this publicity is concerned with the "battle of the brands" but a large portion of it is directed towards educating the public in the merits of changing their motor oil every 1,000 miles. Aside from the commercial aspects of these various programs, the general public has become increasingly "motor oil conscious" and materially benefited in savings through proper lubrication.

IS LUBRICATING GREASE A STEP-CHILD?

But how often is the public reminded that lubricating grease is also a necessary part of automotive lubrication? We in the industry realize this fact, but in the minds of the general public the word lubrication is synonymous with "oil change". In other words, grease lubrication finds itself hidden in the shadow of motor oil lubrication. This, no doubt, is the result of extensive advertising and promotion of motor oil while little or no mention is made regarding the merits of grease lubrication.

In the past the ration of grease lubrication to oil changes has been satisfactory. The consumer's automobile was usually placed on a hoist for oil change and in most cases his automobile was given grease lubrication at this time. But what will happen in the light of recent developments . . . the advent of the "driveway oil change"? Will the automobile owner drive further between grease lubrications because he can secure a "3-minute oil change" and "hasn't the time for grease lubrication."?

EDUCATION, THE COMPANION OF PROGRESS

The "driveway oil change" is a vital reminder that progress is with us. Here is a convenient, time-saving development . . . it shows great promise of increasing motor oil lubrication . . . but will it place grease lubrication further back in importance to motor oil lubrication?

Education is the companion of progress and it appears that the lubricating grease division of the Petroleum Industry must strengthen, in the public mind, the importance of grease lubrication. For there is the possibility that while the motoring public benefits from increased motor oil lubrication that they may lose through decreased grease lubrication.

The largest single investment made by the average American family is the automobile in which they ride. And it is to the filling station operator that they look for guidance in maintaining the value of this investment. This is a large responsibility that rests alike on the shoulders of not only the filling station operator but on the jobber, distributor, and manufacturer of lubricating greases. Education of the consuming public in the necessity of regular grease lubrication is a joint responsibilty. It is not a responsibility without reward, for in our free enterprise system such education will pay large returns.

The Petroleum Industry has accomplished an outstanding feat in educating the motoring public to use motor oils. But the "Cinderella" of the industry, lubricating grease, has yet to take her rightful place in the public mind as a full partner and not a satellite of lubricating oils.

INDEX

APRIL 1949-MARCH 1950

OF ARTICLES APPEARING

Listed By Authors

BLOOMSBURG, H. E. AND BEERBOWER, A.
Plant for Continuous Grease Manufacture
Volume XIII, Number 11, February 1950

BONDI, A., CRAVATH, A. M., MOORE, R. J. AND PETERSON, W. H.
Basic Factors Determining the Structure and Rheology of Lubricating Greases
Volume XIII, Number 12, March 1950

BRUNSTRUM, L. C. AND STEINBRUCH, ROBERT
A Simplified Pressure Viscometer for Semi-Fluid Greases
Volume XIII, Number 8, November 1949

BUNTING, J. T. AND KIPP, E. M.
All-Purpose Greases
Volume XII, Number 1, April 1949

CARMICHAEL, E. S., JONES, F. S., AND ROEHNER, T. G.
Twister Ring Greases
Volume XIII, Number 10, January 1950

GJERDE, M. D.
Proper Lubricants for Farm Machinery
Volume XIII, Number 2, May 1949

HAMILTON, W. E.
A Chat with a Steel Mill Lubricating Engineer
Volume XIII, Number 9, December 1949

LACY, F. E.
Modern Developments in Fats for Grease Manufacture
Volume XIII, Number 1, April 1949

MAPEL, EUGENE B.
A Coat of Arms for Today's Sales Manager
Volume XIII, Number 4, July 1949

MC CONVILLE, H. A.
What is Known About High-Temperature Greases
Volume XIII, Number 4, July 1949

OTT, FRANK
Modern Greases Mean Simplified Lubrication
Volume XIII, Number 3, June 1949

PARKER, KONRAD AND WAGNER, E. F.
Recent Developments in Aluminum Stearates
Volume XIII, Number 6, September 1949

POTTER, R. A. AND MC LENNAN, L.W.
Controlling the Consistency of Semi-Fluid Greases
Volume XII, Number 9, December 1949

RAISCH, C. F.
Improvements in Grease Application
Volume XIII, Number 7, October 1949

SHAW, RAY
Its Time to do a Selling Job
Volume XIII, Number 3, June 1949

VOLD, MARJORIE AND VOLD, ROBERT
The Phase Study Approach to Grease Problems
Volume XIII, Number 5, August 1949

IN THE INSTITUTE SPOKESMAN

Listed By Titles

A CHAT WITH A STEEL MILL LUBRICATING ENGINEER
W. E. Hamilton
Volume XIII, Number 8, December 1949

A COAT OF ARMS FOR TODAY'S SALES MANAGER
Eugene B. Mapel
Volume XIII, Number 4, July 1949

A SIMPLIFIED PRESSURE VISCOMETER FOR SEMI-FLUID GREASES
L. C. Brunstrum and Robert Steinbruch
Volume XIII, Number 8, November 1949

ALL-PURPOSE GREASES
J. T. Bunting and E. M. Kipp
Volume XIII, Number 1, April 1949

BASIC FACTORS DETERMINING THE STRUCTURE AND RHEOLOGY OF LUBRICATING GREASES
A. Bondi, A. M. Cravath, R. J. Moore and W. H. Peterson
Volume XIII, Number 12, March 1950

CONTROLLING THE CONSISTENCY OF SEMI-FLUID GREASES
L. W. McLennan and R. A. Potter
Volume XIII, Number 9, December 1949

FLOATING WHALE FACTORY DELIVERS RECORD SPERM OIL CATCH
Volume XIII, Number 2, May 1949

IMPROVEMENTS IN GREASE APPLICATION
C. F. Raisch
Volume XIII, Number 7, October 1949

ITS TIME TO DO A SELLING JOB
Ray Shaw
Volume XIII, Number 3, June 1949

MODERN GREASES MEAN SIMPLIFIED LUBRICATION
Frank Ott
Volume XIII, Number 4, July 1949

MODERN DEVELOPMENTS IN FATS FOR GREASE MANUFACTURE
F. E. Lacy
Volume XIII, Number 1, April 1949

PLANT FOR CONTINUOUS GREASES MANUFACTURE
A. Beerbower and H. E. Bloomsburg
Volume XIII, Number 11, February 1950

PROFITS FROM A NON-PROFIT RESEARCH INSTITUTE
Volume XIII, Number 2, May 1949

PROPER LUBRICANTS FOR FARM MACHINERY
M. D. Gjerde
Volume XIII, Number 2, May 1949

RECENT DEVELOPMENTS IN ALUMINUM STEARATES
Konrad Parker and E. F. Wagner
Volume XIII, Number 6, September 1949

THE PHASE STUDY APPROACH TO GREASE PROBLEMS
Marjorie Vold and Robert D. Vold
Volume XIII, Number 5, August 1949

TWISTER RING GREASES
E. S. Carmichael, F. S. Jones and T. G. Roehner
Volume XIII, Number 10, January 1950

WHAT IS KNOWN ABOUT HIGH-TEMPERATURE GREASES
H. A. McConville
Volume XIII, Number 3, June 1949

Basic Factors Determining The Structure And Rheology Of Lubricating Greases

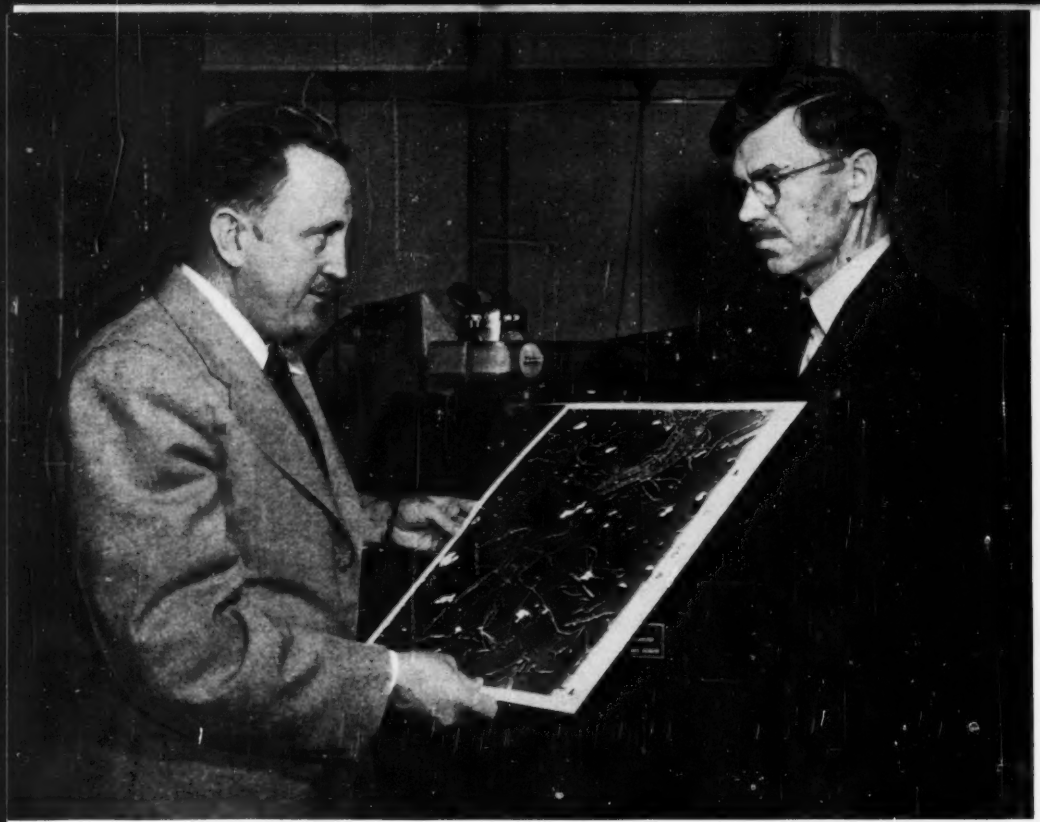
by A. Bondi, A. M. Cravath, R. J. Moore and W. H. Peterson
Shell Development Company
Emeryville, California

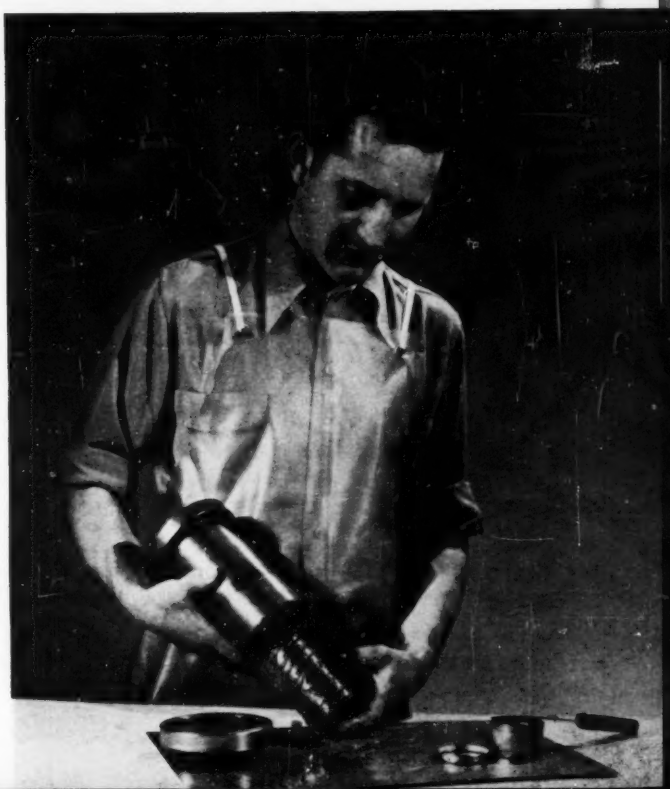
".... basic principles of colloidal suspensions have been developed only recently to permit clarification of what previously had been the 'mysterious art' of grease making."

The increasing importance of greases as lubricants calls for improvements in product quality which can be achieved at reasonable cost only by providing a better understanding of their basic nature. The number of available process and composition variables in grease preparation is so large that material improvements by the common methods, trial and error or intuitive choice of variables, is rapidly becoming uneconomical. Only a coherent picture of the nature of greases in terms of theoretically justified physical concepts can provide a rational choice of promising avenues of approach.

Earlier investigators were hampered in their efforts to apply the classical tools of physics and physical chemistry to the study of lubricating greases because these substances are neither true solids nor true liquids. The basic principles of colloidal suspensions have been developed only recently to permit clarification of what previously had been the "mysterious art" of grease making. The purpose of this article is to illustrate some of the basic concepts used in these Laboratories in the study of grease properties and manufacture.

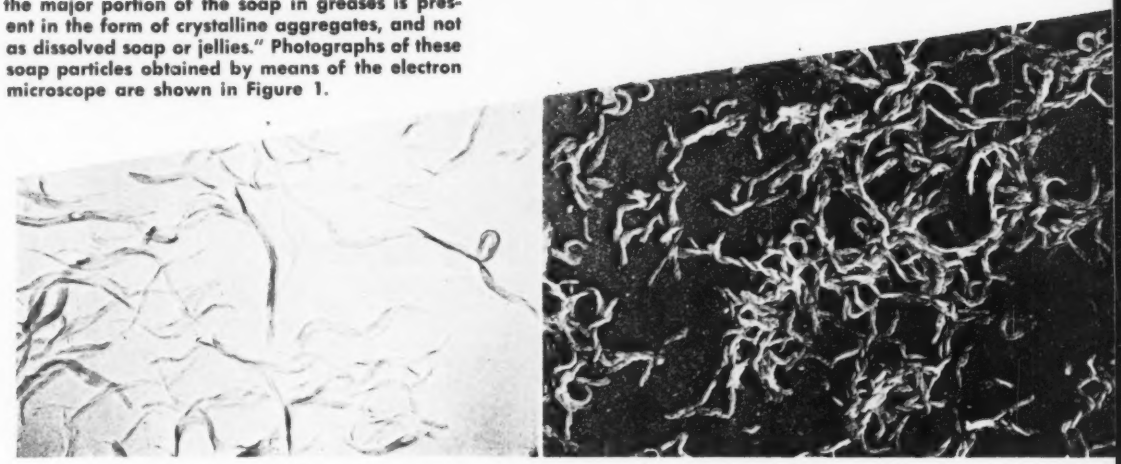
An impressive amount of evidence has been accumulated, particularly from x-ray diffraction and thermal studies which indicates that the major portion of the soap in greases is present in the form of crystalline aggregates, and not as dissolved soap or jellies[1]. Direct photographs of these soap particles have been obtained by means of the electron microscope, typical examples of which are shown in Figure 1. While the crystalline aggregates shown in these micrographs reveal considerable variation in particle structure, the prevalence of fibers is clearly apparent. It is this specific ability of soaps to crystallize in the form of fibers which gives rise to thickening of oil and the particular flow behavior found in the systems we know as grease and which must be treated as one of the fundamentals in attempting to improve a grease. The long, irregular shape of the fibers gives them a form not unlike a mass of wood shavings or excelsior, and thereby they are prevented from settling out. As such, they may effectively encompass a large volume—as much as 100 times their own volume—and the oil component is held in the interstices of this fiber mass by capillary attraction.





Above: Examination of Shadowed Electron Micrograph Showing Fibers from Several Lubricating Greases (magnification or original print shown is 40,000 diameters). The spheres are polyvinyl chloride particles, introduced to furnish a height scale for the shadows.
Right: Taking a Grease Sample out of the Shell Roll Tester.

". . . the major portion of the soap in greases is present in the form of crystalline aggregates, and not as dissolved soap or jellies." Photographs of these soap particles obtained by means of the electron microscope are shown in Figure 1.



1a 1b

In order to demonstrate that fiber geometry alone can lead to the gelation or immobilization of the liquid in which they are suspended, nylon filaments were cut to various length/diameter ratios and mixed with lubricating oils. The data in Table I* show that the consistency of the oil-fiber mixture, as determined with a cone penetrometer, is a direct function of the relative fiber length. Further, there is remarkably close agreement between consistencies of these artificial mixtures and actual greases whose fiber dimension ratios were of about the same value, i.e., the large absolute size of the nylon fibers does not affect the consistency of the suspension. Bleeding is more pronounced, however. This is readily understood in the light of the principles of capillarity, since the static head of liquid that can be balanced by surface tension is lower in a large capillary (the average space between fibers) than in a small one. As a matter of fact, bleeding or oil separation from greases can be treated quite successfully on this basis, and bleeding should not be confused with syneresis or *forcing out* of oil due to contraction of the gel.

TABLE I

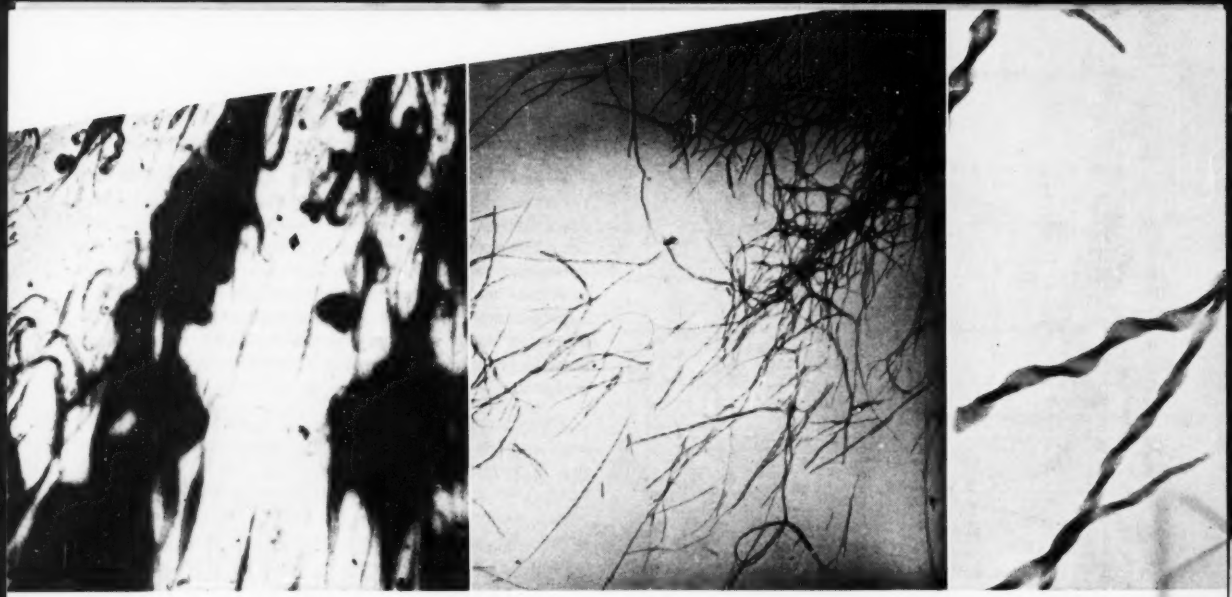
Effect of Fiber Length on Grease Consistency
(10% Nylon Fiber in Turbine Oil)

Axial Ratio	Micro Penetration at Fiber Diameter of		Micro Penetration of Soda Soap Grease
	50mu	16mu	
300/1	95	118	
100/1	165	125	120 (L/D≅170) +
70/1	208	-	200 (L/D≅ 80) +
50/1	∠208	-	
6/1	Fluid	-	

+ L/D ratio (average) determined by solution viscosity and sedimentation volume methods, and is in agreement with electron microscope observations.

As the temperature is raised from room temperature to more elevated levels, but kept below the melting point of the soap, the soap fibers soften stepwise as they pass through their respective phase transitions. These phase changes can be determined in a number of ways, such as by observation of thermal or volume changes, or by x-ray diffraction. This softening process is accompanied by imbibition of the surrounding liquid, i.e., by swelling. The amount of swelling depends very strongly upon the type of soap and the chemical nature of the liquid. In saturated hydrocarbon oils of more than 300 molecular weight the alkali metal soaps swell very little, but some soaps swell extensively in aromatic solvents. The tendency of a soap to swell is largely determined by the internal strength of the soap crystal as measured by the total heat of transition at the temperature of the swelling measurement. Sodium stearate passes through a number of transitions and swells up to 300% by volume in an aromatic oil at 140°C. Lithium 12-hydroxystearate does not have any phase changes up to about 160°C and does not swell at all under the same conditions[5]. It is to be expected that the resistance of a grease to breakdown at these elevated temperatures will be affected by this soap-oil interaction and attendant changes in the soap structure. Obviously it is of interest to determine these inter-relationships using the tools now available before extensive work on formulation and field trials are undertaken.

As the temperature is raised still further the crystalline soap in a grease finally passes into solution in the oil. The solubility curves of most soaps in hydrocarbon oils are so steep that the solution temperature of a soap in oil in the concentration range usually employed for grease making (3 to 20%) is almost independent of concentration, and not much lower than the melting point of the soap[4,8,18]. The transition from the mixture of swollen fibers to homogeneous solution is not always sharp. In some instances, notably with many sodium soaps, a jelly-like state intervenes in which



1 c Barium Grease (8000X)

1 d Lithium Hydroxystearate Grease (8000X)

1 e Lithium Hydroxystearate Grease (40,000X)

the system is flow birefringent. No data are as yet available which permit definition of the phase state of the soap in this temperature range. It is important to recognize, however, that the fiber structure may be radically changed by an excursion into the "jelly" phase so that a definite temperature limit can be predicted on the basis of such information.

The measurement of the flow properties of lubricating greases both for process control and for the adaptation of greases to be given mechanical applications has seen rapid development during the past decade[1,2,5,6,17]. Owing to the efforts of the A.S.T.M. and C.R.C. Committees concerned with this work, methods have been worked out for the reproducible determination of consistency by means of the cone penetrometer[18], and of flow resistance by means of the S.O.D. pressure viscometer[6]. Careful examination of the basic premises of these methods has shown that they describe the flow properties of greases in a relatively unequivocal fashion only if all of the (arbitrarily) established operating conditions are strictly followed. The "real" flow characteristics of a grease may therefore never be established by following the standard procedures.

An example is the capillary extrusion viscometer, which is intended to permit prediction of the pressure drop in grease dispensing systems. Analysis of the data obtained with capillaries of the type commonly employed in the S.O.D. Viscometer, but of different lengths (L/D 10 and 40) indicated that at low shear rates as much as 50% of the driving pressure (in the S.O.D. viscometer for which L/D=40) may be consumed just to force the grease into the capillary entrance. The viscosity calculated from the pressure and flow rate data is consequently much too high and much higher than would be effective in a long pipe for which the entrance loss would be negligible. A plot of the viscosity corresponding to the shear stress corrected for entrance losses and of viscosity data obtained on a concentric cylinder instrument vs. shear stress showed that over a wide range of shear stress the grease viscosity is independent of the shear stress (see Figure 2)[15]. This may be taken to mean that in this shear stress range, which often falls in the range encountered in plant pumping operations, the grease slides via plug flow on a layer of oil (possibly 50 to 100mu thick) instead of being sheared in laminar flow throughout the pipe crossection. The determination of the viscosity "effective" in pumping operations may thus be more easily and more reliably determined in the concentric cylinder viscometer than by means of the capillary instrument.

The instantaneous values of consistency and viscosity mentioned above by which the usefulness of a grease for a given application is characterized are not definite constants but change sometimes very substantially during storage and even more so during continued exposure to shear. The latter factor, often termed the "mechanical stability" of a grease is one of its most important properties. It may be defined as the lifetime of consistency under a given set of shearing conditions. Well known shearing conditions are the kneading in the ASTM Grease Worker, which when equipped with the small hole plate specified for ANG-15 Grease, obtains shear rates of the order of 5000 sec^{-1}, and the Shell Roll Test[10] the exact shear conditions of which are not known. Several other pieces of apparatus for examining the shear stability of greases have recently been proposed[13,18].

Study of the breakdown process of greases has shown that there is no fundamental difference in the action of the ASTM worker and the Shell Roll Test, except in rate of breakdown. Inasmuch as the consistency of a grease is determined by the length/diameter ratio of the soap fibers present, a loss in consistency of a grease must be the result of fiber breakage leading to a lower length/diameter ratio. This breakage and its ramifications will be treated in greater detail in another paper[19] but an indication of the extent of fiber breakage that is encountered is shown in Figure 3.

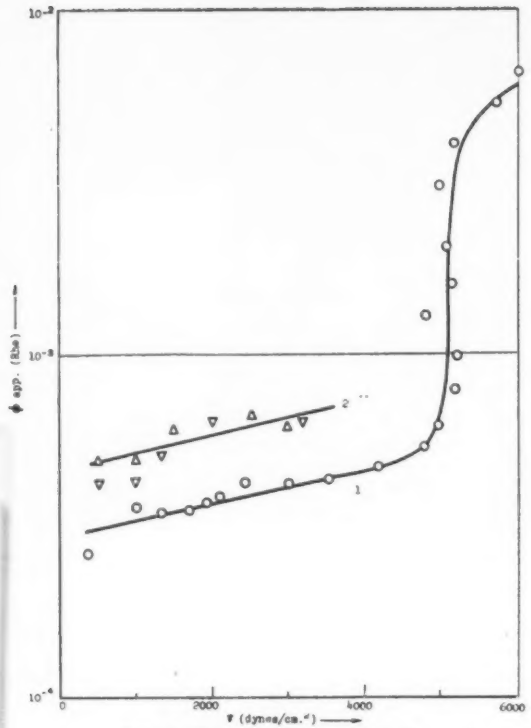


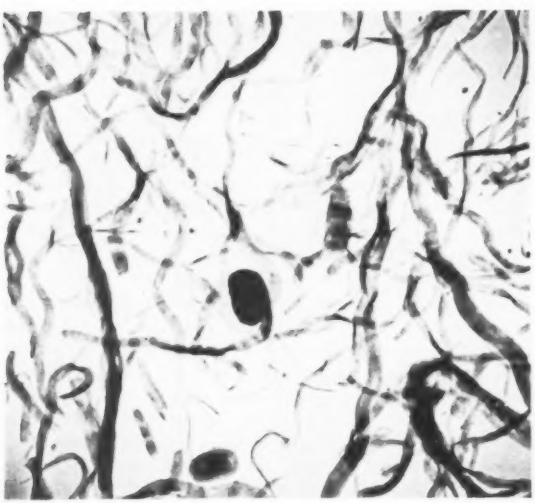
Figure 2. Above. Apparent Fluidity of Soda Base Grease, Curve 1— Calc. from Extrusion Measurements at 25°C. Corrected (Approximately) for end effects. Curve 2 — Calc. from Couette Viscometer Data at 30°C. Two different Viscometer Fillings.

Figure 3. Below. Breakdown of Conventional Hydrous Soda Base Grease

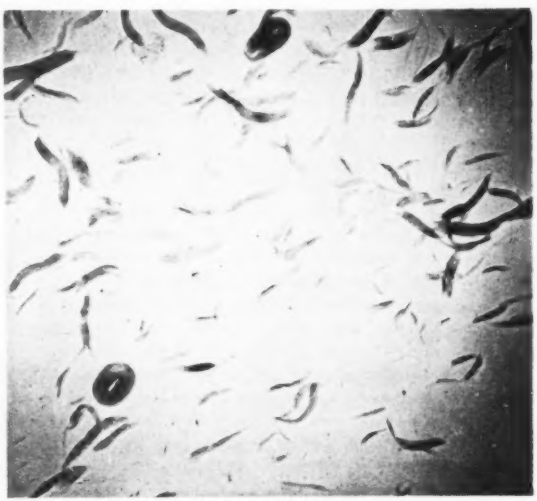
This electron micrograph of a soda base grease, obtained after a few hours in the Shell Roll Test, may be compared with that of the original unworked grease shown in Figure 1a. The reduction in fiber length is most striking.

Actually, the breakdown process is not confined to such strenuous long-time influences but can be initiated by very small forces. The change in viscosity found during a viscosity measurement in which a shear stress of only 1400 dynes/cm^2 was used is shown in Figure 4. This shear stress is just of the order of the yield value of this grease. It is apparent that the very act of measurement changes the properties of a grease perceptibly. At higher shear stresses the change is even more rapid since the rate of breakdown is higher.

The viscosity and consistency of a sheared grease may increase quite rapidly, on the other hand, once it is again at rest. Apparently the soap fibers lying one on another can form rather rigid bonds, possibly crystallization points which give a temporary "set" to the grease. This thixotropic recovery can stop at a lower, the same, or even at a higher consistency level than that of the unsheared grease, depending upon the characteristics of the soap used. How seriously the measurement of rheological properties can be affected by this recovery is shown in Figures 5 and 6 where viscosity and consistency, respectively, are shown after various intervals of time. The combined effects of shear breakdown and recovery result in a situation which is exceedingly difficult to assess by routine methods; the properties measured at any one moment are not absolute quantities but are conditioned by the mechanical treatment of the grease prior to and during the measurement as well as by the interval of time elapsed between treatment and measurement. These observations serve to emphasize the importance of exactly specifying the conditions under which a given grease has been tested when reporting its rheological properties. At the same time the very act of "exactly specifying conditions" can be a trap for the unwary researcher who is



Unworked



Roll Tested 4 hours.

satisfied by a table of data. Parenthetically, the procedure for determining grease consistency following the 100,000 stroke Navy test is just such a trap in that some poor greases are given ample time for recovery of their consistency before determination.

The ultimate objective of even fundamental work in industrial grease research is the development of lubricants for given mechanical applications. Too often, however, the suitability of an experimental lubricant is measured in actual or simulated field equipment without regard for the various possibilities for failure. For instance the performance characteristics of wheelbearing greases are determined in automobile front wheels or in the heated hub and bearing assembly, commonly known as AXS1574 Army Wheelbearing Tester[20]. The performance in this service is obviously determined by the cooperation of a number of mechanical properties each of which should really be studied separately if any progress is to be made in grease development. Accordingly failures of greases in actual truck wheel bearings were carefully analyzed. Aside from chemical stability characteristics, the following properties were found to be of basic importance: (a) the mechanical stability of the grease over the normal temperature range of operation, which could be determined with the Shell Roll Test or any related test, and (b) the maintenance of consistency under static conditions over an extended temperature range. A simple so-called "slump test" was devised to evaluate the latter property comprising a ¼" grease layer smeared on the inside wall of a 600 ml. beaker which was then heated at progressively higher temperature until the grease flowed or slumped down and/or bled excessively. Alternatively, one may determine the consistency-temperature curve up to about 120°C. The results of test (a) predict whether the grease will become fluid in the roller bearings under the influence of constant shearing, and test (b) predicts the ability of the grease to "stay put" in the hub, even when repeated application of the brakes causes the hub to become heated (see Table II). These test criteria were developed by direct observation of grease behavior in the field without recourse to expensive facsimile equipment in the laboratory.

Figure 4. Breakdown During Viscosity Measurements in Couette Viscometer.

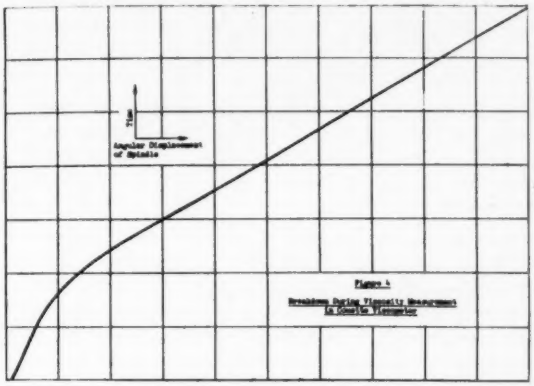


Figure 5. Recovery after Shearing as observed in Couette Viscometer.

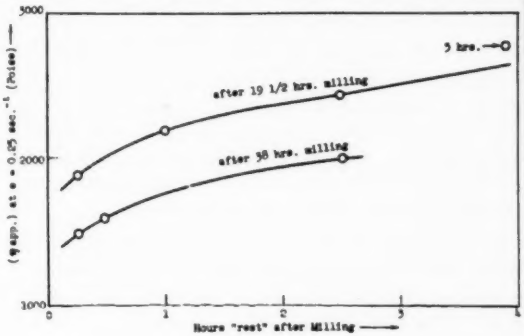
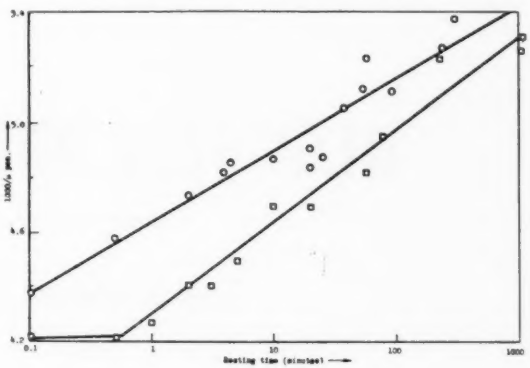


TABLE II

Correlation of Wheelbearing Performance in Truck Service with Laboratory Data

Grease	Consistency (ASTM Cone Penetration at 25°C after 60 strokes)	Roll Life (hrs. to 230 micro Penetration at 25°C)	Slump Temp. (approximate)	Truck Performance
No. 252	311	210	starts at 100°C	(Slumps in hub) Poor
No. 274	299	200	about 130°C	Good

Figure 6. Recovery in Consistency equals Reciprocal of Microcone Penetration after Shell Ross Test of Two Typical Greases.



Note: Check tests of these samples were carried out by the staff of the Research Laboratories of Shell Oil Company, Martinez, California, with the Army Wheel-bearing Tester. Ratings were in the same order as shown above.

It is felt that an analysis of critical operating conditions along the lines suggested by this example may be more valuable for the development of better lubricating greases than the "passing of tests" on complex and expensive mechanical rigs.

The fundamental concepts involved in development research on lubricating greases have been surveyed in the light of selected examples with respect to structure, rheology and behavior of grease. It is shown that the structure and consistency of conventional lubricating greases are determined by the geometry of the crystalline soap particles present in the grease in the form of an aggregation of fibers. Loss in consistency on working is due to mechanical degradation of the fibers and the rate of degradation under fixed shear conditions depends upon the type of soap used. At elevated temperatures the soap fibers may become excessively weak due to swelling of the soap by small amounts of aromatic hydrocarbons; of the soaps tested only lithium 12-hydroxystearate resisted swelling up to about 160°C.

Viscometry of greases is discussed and it is shown that the act of viscosity measurement itself affects the viscosity of a grease. Conversely, thixotropy may affect consistency determinations even at relatively short periods of time. The recovery of consistency after shearing is illustrated by measurements with a viscometer and a penetrometer.

In a correlation of field and laboratory results, it is shown that the behavior of a lubricating grease in automobile wheel bearings can be predicted from a knowledge of its shear stability as ordinarily determined in the laboratory, and the consistency at elevated temperatures.

ACKNOWLEDGMENT

The L/D ratios of soap fibres (Table I) were determined by Dr. J. N. Wilson of this Laboratory.

BIBLIOGRAPHY

1. Arveson, M. H., Ind. Eng. Chem., *24*, 71 (1932); *26*, 628 (1934).
2. Blott, J. F. T. and Amner, H. W., Proc. Internat'l Rheol. Congr., 1948.
3. Blott, J. F. T. and Samuel, D. L., Ind. Eng. Chem., *32*, 68 (1940).
4. Bondi, A., J. Chem. Phys., *16*, 157 (1948).
5. Bondi, A., to be published.
6. Coordinating Research Council, Project No. CLLG-20-43, Summary Report, 1946.
7. Farrington, B. B. and Birdsall, D. H., Inst. Spokesman, *11*, No. 1, 4 (1947), J. Phys. Coll. Chem., *52*, 1415 (1948).
8. Leggett, C. W., Jr., Vold, R. D., and McBain, J. W., J. Phys. Chem., *46*, 429 (1942).
9. McLennan, L. W. and Smith, G. H., ASTM Bull., *152*, 123 (1948).
10. McFarlane, R. P., Inst. Spokesman, *6*, No. 12 (1943).
11. McKee, S. A. and White, H. S., ASTM Bull., *153*, p. 90, August 1948.
12. Pigott, R. J. S., Inst. Spokesman, *11*, No. 9, December 1947.
13. Smith, G. H., Ph.D. Thesis, Stanford, 1946.
14. Vold, M. J., Hattiangdi, G., and Vold, R. D., ACS Meeting, San Francisco, 1948.
15. Wilson, J. N. and Bondi, A., to be published.
16. Wilson, J. W. and Smith, G. H., Ind. Eng. Chem., *41*, 770 (1949).
17. Zimmer, J. C., et al., Inst. Spokesman, *6*, No. 8, 9 (1942); 10, 11 (1943), *7*, No. 12 (1944), *8*, No. 1 (1944), *9*, No. 5 (1945).
18. ASTM Standard D-217-38T.
19. Moore, R. J. and Cravath, A. M., in preparation.
20. ASTM Standards on Petroleum Products and Lubricants, p. 619, November 1948.

Reservations are coming in regularly for the 1950 Annual Meeting.

Have you yours?

NLGI 18th ANNUAL MEETING

October 30, 31, and November 1

EDGEWATER BEACH HOTEL

Chicago, Illinois

Bound Volumes

of

The INSTITUTE Spokesman

YOU HAVE
BEEN ASKING
FOR THEM . . .

HERE THEY ARE!

All 12 copies published from April, 1949 through March 1950. Attractively bound, lettered in gold on the front cover and binding. A permanent and authentic reference book for your library.

A VERY LIMITED QUANTITY AVAILABLE

Per Complete Copy $5.00

All orders will be filled as received until the supply is exhausted

SO Fill Out the Coupon Below NOW and Assure Yourself of At Least One Copy

Please enter my order for_____ copies of Bound Volume No. XII of The Institute Spokesman. Send invoice for_____ at $5.00 apiece.

NAME_____

COMPANY_____

STREET_____

CITY_____

STATE_____

MAIL THIS COUPON TO:

NATIONAL LUBRICATING GREASE INSTITUTE
4638 Mill Creek Parkway, Kansas City 2, Mo.

GREASONALITIES

FRANK C. KERNS AND F. E. ROSENSTIEHL . . . F. C. Kerns resigned from the NLGI recently when he retired to private life from the Texas Company. At the time of retiring Mr. Kerns held the position of Manager of the Lubricating Sales Division of the General Domestic Sales Department. Replacing him as Texaco's representative to the N.L.G.I. is F. E. Rosenstiehl, who also has been elected to fill the vacancy left by Mr. Kerns on the Institute's Board of Directors.

Mr. Kerns joined the Texas Company on January 23, 1911 as a stenographer in the Lubrication Division in Houston.

F. C. KERNS

F. E. ROSENSTIEHL

With a long and varied career in the field of lubrication, Mr. Kerns has achieved distinction in his work and has been honored by many groups in his field. He is a past president of NLGI and his memberships include The Society of Automotive Engineers, the Chemists' Club of New York, the Society of Lubrication Engineers, the American Transit Association and Lubrication Committee of the API.

In 1918, Mr. Rosenstiehl joined the Texas Company at their Bayonne, New Jersey Laboratory working successively as Tester, Chemist and Chemist in Charge of the Analytical and Testing Department. In 1929 he was transferred to the New York office of the Technical and Research Division, becoming Supervisor of Technical Service in 1938. In 1942 he became Assistant Manager of the Technical and Research Division in charge of Technical Service activities, leaving that position to succeed Mr. Kerns as Manager of the Lubrication Sales Division of the General Domestic Sales Department.

Among his many and varied activities in the petroleum industry he has been consultant to federal, state and industrial groups on petroleum and has obtained patents covering the composition of lubricants.

Active in the American Society of Testing Materials, he also is a member of the American Society of Mechanical Engineers, Petroleum Applications Committee, the American Society of Lubrication Engineers, the American Chemical Society, the Chemists' Club, New York, and the Navy Cooperative Committee on Fuels and Lubrications and the API.

DEEP ROCK PROMOTION . . . Carl A. Houy, who began as a roughneck in the Texas oil fields 13 years ago, has been appointed general superintendent of crude oil production for Deep Rock Oil Corp., Richard K. Huey, vice-president of the company's production division, announced in Tulsa today.

Mr. Houy attended the Schreiner Institute at Kerrville, Texas, then specialized in petroleum engineering at the University of Texas. He began his working career with the Humble Oil and Refining Co. at Refugio, Texas, in 1937.

In 1940, he transferred to the Republic Natural Gas Co. at Dallas as engineer and assistant superintendent, and steadily progressed until he was vice-president in charge of gas engineering, production and supply at the time he joined Deep Rock.

Mr. Houy is a member of the American Petroleum Institute, Independent Petroleum Association of America and the Natural Gas Association. Mrs. Houy and two children accompany him to Tulsa.

DEEP ROCK FILLS TWO NEW POSTS . . . Two newly-created supervisory posts have been filled at Deep Rock Oil Corporation's Cushing, Oklahoma, refinery, W. J. Carthaus, vice-president, manufacturing and research division, announced today.

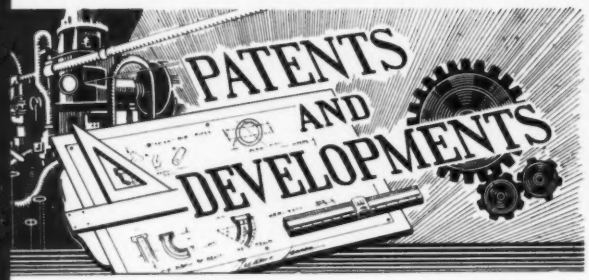
T. G. Stevenin, recently chemical engineer of the U. S. Government's Northern Regional Research Laboratory at Peoria, Ill., was named plant technologist and J. W. Beam, formerly instrument engineer with Universal Oil Products Co. was appointed supervisor of the instrument department.

Stevenin obtained his first B. S. degree in chemical engineering from the University of Kansas in 1939, and another in general agriculture from the University of Illinois in 1948. Following earlier experience in Standard Oil Co. of Indiana's Whiting refinery, he served as process engineer for Phillips Petroleum Co. at Bartlesville, Okla.

Beam attended schools in his home state of Georgia, including Georgia Tech, before receiving his B. S. degree in engineering from Purdue University in 1944. In 1945 he joined Universal Oil Products and became the company's chief field instrument engineer before joining Deep Rock.

NLGI VISITORS TO THE INSTITUTE OFFICE . . . R. F. McClellan, Metasap Chemical Company, was here during February and called the National Lubricating Grease Institute office. He told us that Nels Gothard, Sinclair Refining Company, is confined to his bed in the Little Company of Mary Hospital in Chicago, Illinois after suffering an accident breaking his hip.

Another representative to the NLGI and notable in our industry was in Kansas City recently and called the Institute office; Ben Lewis, Vice-President of Witco Chemical Company.



LITHIUM-BASE GREASES

According to Meyer of Foote Mineral Co., lithium-base greases are now replacing many earlier types and have established a place for themselves in the industrial, automotive and aeromotive fields. By introduction of lithium greases, a large number of specialized products have been eliminated, and such greases are non-emulsifiable, reversible, chemically stable, shear stable, and satisfy a wide temperature service range. The article describes the various processes for making greases, and outlines the patent situation on lithium greases (Petr. Engr. 1-50 p.C-5).

JET LUBRICATION FOR GEAR GREASING

The Harding St. Plant of Indianapolis Power & Light Co. is employing a jet greasing device developed by Spangler which greatly simplifies gear greasing. It is a cylindrical grease container fitted with a pipe having a compressed air inlet connected to an air hose. A filler plug allows filling of the cylinder with a grease which is a special combination of a heavy gear lubricant and carbon tetrachloride, the latter acting as a thinner which evaporates upon application. (Elect. World 1-16-50 p.94.)

ELECTRIC MOTOR LUBRICATION

The January 1950 issue of The Texas Company publication "Lubrication" is devoted to electric motor lubrication and includes a section on selection and use of greases.

GREASE VISCOMETER

Precision Scientific Co. has redesigned the Interchemical Rotational Viscometer which it now recommends for obtaining flow properties of greases and other similar products. The apparatus produces consistency curves in place of single point measurements, since the latter may be misleading for plastic and thixotropic materials. Essentially, it is a rotating sample cup containing an immersed stationary bob, the viscous drag on which is measured (Petr. Proc. 1-50 p.83).

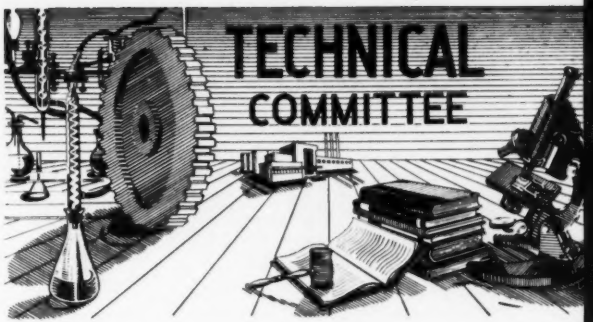
ALUMINUM STEARATE SOLUTION

A patent issued to Nopco Chemical Co. covers a free-flowing composition containing 3-50% aluminum stearate, 0.25-20% alkyl ester of phosphoric acid containing a total of at least three carbon atoms, and a liquid solvent for the aluminum stearate, such as terpenes, aromatic hydrocarbons, aliphatic hydrocarbons, and chlorinated hydrocarbons (U.S. 2,494,331).

HIGH TEMPERATURE BALL BEARING GREASE

An improved lubricating grease adapted for lubrication of ball bearings, roller bearings, etc. at high temperature, is covered in a patent by Socony-Vacuum Oil Co., Inc. It contains a major proportion of lubricating oil and 15-30% of an alkali metal soap of a fatty acid having an iodine number of 60-170. The grease is compounded by incorporat-

(*Continued on page* 23)



Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

Two groups have been added recently to the list of committees organized to tackle problems involving evaluation and application of lubricating greases. Carl Georgi, Quaker State Refining Corporation, as Chairman of Subcommittee C on Chassis Lubricants and SAE Fuels and Lubricants Technical Committee, has started preparation of a write-up on General Information on Chassis Lubricants for possible inclusion in the SAE Handbook. The second and much larger group represents a healthy revival of the Co-ordinating Research Council's interest in grease problems. "In response to a request from the Air Force and the Navy Bureau of Aeronautics, CRC is organizing a group of industry representatives to assist the military in evaluating the performance requirements of modern and future aircraft as regard airframe and accessory lubricants. It will be the function of this group to assess the lubricant requirements of the various mechanisms built into the airplane design, particularly for greases, and enable changes to be made by each industry to obtain the best overall effectiveness of our air arm. The group will also assist in the development of laboratory testing techniques which will predict field service performance and assist in the development of satisfactory lubricants and airframe components.

"Aircraft designs are progressing at an extremely rapid rate and will continue to do so. If the proper development of greases is to keep pace and if improved aircraft designs are not to be held back, it is essential that the objective of this group be fulfilled.

"The group is being organized under the leadership of D. N. Harris, Aeronautical Engineer for Shell Oil Company, San Francisco, California, and two sub-groups are being formed within the main committee. A Service Evaluation Panel, under the leadership of D. H. Moreton of Douglas Aircraft Company, Santa Monica, California, will have the assignment of obtaining the necessary data to permit establishing the lubricant performance requirements in technical terms that can be used by a Laboratory Study Panel under the leadership of E. S. Carmichael of Socony-Vacuum Oil Company, Inc., Brooklyn, New York.

"The leaders of this group fully appreciate the magnitude and scope of the job they are undertaking and they recognize that their success in fulfilling the needs of the military will depend to a great extent upon the cooperation received from

(*Continued on page* 24)

Books and Publications

about the industry

INDUSTRIAL CHEMISTRY

by E. Raymond Riegel . . . $7.00

The fundamental purpose of this book is to give you a picture of an industry, process or installation, such as you might take away after a personal plant visit in which you study all operations from basic chemical reactions to finished products. To this nucleus there is added a broader description of each industry: indication of size by means of production figures; a modest amount of theoretical data; and a liberal amount of equipment information in words, pictures and numerous sketches. Many qualified specialists contributed time and advice to help make this book unrivalled for accuracy, scope, clarity and inclusiveness.

Whether you are a chemist, engineer, business executive, stockholder, banker, educator or editor, you will find valuable information on the latest practices in the chemical industry but complete commercial, economic and technical information as well.

QUALITY CONTROL and Statistical Methods

by Edward M. Schrock . . . $5.00

In clear, straight-forward language this book takes you step by step through the operations of applying statistical methods to the problems of modern industrial quality control.

This book is intended for those who are new to the field who want to improve their effectiveness in appraising and controlling the quality of products or the economy of methods to increase production. By the use of many illustrations and practical examples, it will help you apply the most modern methods to your specific needs. This book involves any field where the quality of product must be appraised and controlled and includes numerous topics, materials and useful tables not previously covered.

HYDRAULIC MACHINERY

by Samuel R. Beitler and Eric Lindahl . . . $3.50

This book has been prepared for use in a course given to fourth year mechanical engineering students. Its purpose is to give the student a general knowledge of the fundamental principles upon which hydraulic machines operate, a brief review of fluid mechanics, and considerable descriptive matter about machinery as it is constructed today. The descriptive material is supplemented by many illustrations where these will aid the student to understand what is being presented.

This textbook is one that will prove of real value to the teacher for use in any course similar to the one for which it has been prepared, or as supplementary material for those wishing to show applications of fluid mechanics to actual machines. It will also serve as collateral reading in course in which certain special machines, such as centrifugal pumps or turbines, are studied in greater detail than is possible in a general course.

ALEX P. FOX'S "WHAT LUBRICATION MEANS TO INDUSTRIAL MANAGEMENT." . . . Alex P. Fox, President of Lincoln Engineering Company, prepared a booklet entitled "What Lubrication Means to Industrial Management." The material in this book is said to comprise a clear and sharply defined analysis of the chaotic condition of present-day industrial lubrication practices and suggests the tried and proven methods of solution.

Lincoln Engineering Company has been promulgating these same solutions to the product design engineer and the industrial plant manager in their national advertising. The company announces that the booklet has been released and copies are available without charge by addressing a request to them, 5730 Natural Bridge Avenue, St. Louis, Missouri.

1949 A.S.T.M. STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS

(With Related Information)

This latest (November 1949) compilation of A.S.T.M. Standards on Petroleum Products and Lubricants (With Related Information) brings together in compact, readily usable form, most of the A.S.T.M. standards, test msthods, and specifications widely used in this field. (The methods of test for knock rating of engine fuels are issued in a special manual and not included in this compilation.)

Prepared by A.S.T.M. Committee D-2 on Petroleum Products and Lubricants, this edition gives in their latest form 120 A.S.T.M. standards, including 102 test methods, 12 specifications, 2 lists of definitions relating to petroleum and rheological properties of matter, 2 tentative recommended practices for the purchase of uninhibited mineral oil for use in transformers and in oil circuit breakers, and for designating significant places in specified limiting values; and other material. Covered are motor and aviation fuels; diesel and burner fuels, kerosine and illuminating oils; lubricating oils; greases; petrolatums and paraffin waxes; plant spray oils and petroleum sulfonates; cutting fluids; electrical insulating oils; light hydrocarbons; hydrocarbon solvents; crude petroleum; thermometers; and miscellaneous.

New material includes tentative test methods for: aniline point and mixed aniline point of hydrocarbon solvents; benzene and toluene by ultraviolet spectrophotometry; hydrogen in petroleum fractions by the lamp method; olefinic plus aromatic hydrocarbons in petroleum distillates; acetylene in polymerization grade butadiene by lisver nitrate method; oxygen in butadiene vapors by manganous hydroxide method; peroxides in butadiene by ferrous-titanous method; separation of residue from butadiene; butadiene dimer in polymerization grade butadiene; nonvolatile residue of polymerization grade butadiene; sodium in lubricating oils and lubricating oil additives; distillation range of lacquer solvents and diluents; and tentative methods of testing and standardization of etchedstem liquid-in-glass thermometers.

NLGI MAILING . . . Here's a note! During the week of February 10, 18 Post Office sacks of NLGI mail were carried out of the Institute's office. Nine of these sacks were filled with THE INSTITUTE SPOKESMAN. Not too long ago, the SPOKESMAN was transported to the Post Office in the back seat of a taxicab.

(*Continued from page* 21—*Pat. & Dev.*)
ing the acid-containing ingredient in some of the oil, saponifying the acid, and then raising the temperature of the mix slowly to a 500-540 F, followed by holding the temperature at that level for at least about 20 minutes, sufficient to bring about polymerization of the fatty acid component (U. S. 2,495,651).

MOLYBDENUM LUBRICANT — Lockrey Company of College Point, New York is introducing its Liqui-Moly lubricant with a molybdenum base which can be added to other lubricants (J. Commerce 1/24/50 p.18).

HIGH PRESSURE GUN—Walworth Company is advertising its new high pressure lubricant gun which is said to save over 50% of the time generally required to lubricate plug valves (Petr. Ref. 1/50 p. 20).

OTHER PATENTS AND APPLICATIONS—Brit. Appl. 31, 678-81/49 (Sci. & Indus. Res., Honorary Adv. Council) —Lubricating greases. Can. Pat. 462,266 (Tecalemit Ltd.)—Greases gun. U. S. 2,493,891 (McCarty) — Grease gun cartridge.

Penn-Drake

PETROLATUM

For the Grease Maker

Specify PENN-DRAKE for the pure dark grade PETROLATUMS necessary for maintaining the uniformly high quality of your greases. PENN-DRAKE PETROLATUMS will not melt, sweat or become "runny" even at high summer temperatures. May we send specifications or samples?

PENNSYLVANIA REFINING COMPANY

General Offices: BUTLER, PA.
Branches: Cleveland, Ohio; Edgewater, N. J.
Representatives in Principal Cities

TESTS THAT DISTINGUISH TYPES OF LUBRICATING GREASES —When rolling-contact bearings are to be used in services where unusually high or low temperatures are encountered, it is essential to know that the grease with which they are packed is suitable for the application. McConville of G. E. shows how minute samples are adequate to identify various approved greases (G. E. Rev. 11/49, p. 9).

ASTM MEETINGS AHEAD IN 1950

Committee B-4 on Electrical Heating, Resistance and Related Alloys
March 1-2
ASTM HEADQUARTERS

Philadelphia District (Air Pollution)
March 8
PHILADELPHIA, PENNSYLVANIA

Joint SAE-ASTM Technical Committee on Automotive Rubber
March 8
DETROIT, MICHIGAN

Committee D-13 on Textile Materials
March 15-17
NEW YORK, NEW YORK

Committee D-9 on Electrical Insulating Materials
Week of March 20 (Tentative)
OLD POINT COMFORT, VIRGINIA

Committee D-20 on Plastics
Week of March 20
OLD POINT COMFORT, VIRGINIA

Committee D-12 on Soaps and Other Detergents
March 21-22
NEW YORK, NEW YORK

St. Louis District (Stress Analysis in Action)
March 28
ST. LOUIS, MISSOURI

Chicago District (Functional Photography in Industry)
March 29
CHICAGO, ILLINOIS

Committee D-10 on Shipping Containers
April 27-28
MADISON, WISCONSIN

53rd ANNUAL MEETING and 9th Exhibit of Testing Apparatus and Equipment
June 26-30
ATLANTIC CITY, NEW JERSEY

Dates have been set for the 1951 and 1952 Annual Meetings of the American Society for Testing Materials. The 1951 meeting is to be held June 18 through June 22, tentatively in Atlantic City. June 22 through June 27 are the dates of the 1952 meeting which is planned for New York City.

Laboratory improved

Automotive Lubricants

•

Greases and Cutting Oils

PENOLA INC.
15 West 51st St., New York 19, N. Y.

AMERICAN LUBRICANTS, INC.
Buffalo, N. Y.

1922

SERVICE
and
GREASES
from
a
CENTRAL POINT

(*continued from page* 21)

the associated industries. They have expressed a hope that any problems or information concerning aircraft lubricant requirements be brought to their attention, because it is their sincere desire that the thinking and attitude of all of the associated industries will be considered and incorporated into the work of the group."

The Subcommittee on Grease Testing Machines, ABEC-NLGI Co-operative Committee on Grease Test Methods, held a meeting on January 17th. This group is working on the redesign of the ABEC Testing Machine which is one of the grandpas of functional testers of greases. It will be recalled that the tester is not designed for long-time stability runs, and is intended for use primarily as a screening test machine. Under the chairmanship of Carl T. Hewitt of The Fafnir Bearing Company considerable progress has already been achieved.

(*Continued from page* 22)

Appendices include, in addition to report of Committee D-2 on Petroleum Products and Lubricants, proposed methods of test for: determination of micro cone penetration of lubricating grease; apparent viscosity of lubricating greases; sulfur in petroleum products by the CO_2-O_2 method; boiling point range of polymerization grade butadiene; phosphorus in lubricating oils, lubricating oil additives, and their concentrates; bromine number of petroleum distillates (color indicator method and electrometric method). Also, proposed definitions, functions, types and designations of cutting fluids; carburetor jacket for use with motor and research methods to rate high vapor pressure fuels; method for determination of color index of petroleum products by photoelectric colorimeter; and measuring the temperature of petroleum and petroleum products. There are also recommendations on the form of A.S.T.M. methods of test for petroleum products and lubricants; list of proposed methods prepared by Committee D-2 and published as information prior to 1949 and of other A.S.T.M. publications on petroleum products and lubricants; regulations governing A.S.T.M. Committee D-2 and list of its personnel.

Copies of this 750-page book can be procured from American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $5.00 each, heavy paper cover; $6.15, cloth cover.

CORRECT LUBRICATION

SOCONY-VACUUM

GARGOYLE
Lubricants

Backed by the World's Greatest Lubrication Knowledge and Engineering Service

SOCONY-VACUUM OIL CO., INC.
26 BROADWAY NEW YORK, N. Y.

TESTED LUBRICANTS FOR

Power House • Shop
Construction • Highway
All Industrial and
Automotive Uses

SINCLAIR

SINCLAIR REFINING COMPANY
630 Fifth Avenue, New York 20, N.Y.

(*Continued from page* 8)

The tester is built simply and strongly. Rigidly mounted on a 1¾ inch steel plate base, the noise and vibration is at a minimum. The coupling shaft is fitted with airplane-type bearings which are especially suitable for the application. The base, guard and motor housing are finished in attractive Neutra-Green Hammerloid baked enamel. This coating is corrosion-resistant, and presents a tough, durable surface against blows and scratches. Other parts are nickel-plated. Motor has ½ H.P. and operates on 115 volts, 60 cycles, A.C. Overall Dimensions 18″ wide, 12″ deep, 12″ high.

TWO NEW MEMBERS

On page 35, on which appears a listing of Associate Members to the National Lubricating Grease Institute, there are two new names. Rheem Manufacturing Company, New York and Farmers Union Central Exchange, Inc., St. Paul, joined NLGI during February. In the March issue of the SPOKESMAN, there will be an article about both companies and their representatives to the Institute.

For
QUALITY GREASE MAKING
• Neutral Oils
Viscous and Non-Viscous
• Bright Stock
• "G" Cylinder Stock
UNIFORM, DEPENDABLE
Write today for samples and prices
DEEP ROCK OIL CORPORATION
616 So. Michigan Ave., Chicago 90, Ill.
DEEP ROCK

CARS COMPETE IN ROAD TESTS

At least 25 different 1950 model cars, under the supervision of the American Automobile Association Contest Board, started from Los Angeles February 15 on a rugged two-day run. The ride took them over mountains, down valleys, across deserts and through cities to the South Rim of the Grand Canyon, some 750 miles away. Numerous engineering improvements were expected to come out of this competition, by which American motorist will profit.

The route of the run covered altitudes from below sea level to high mountain passes, through temperatures varying from extreme below zero cold to oppressive heat. The cars participating in the run were subjected to almost every imaginable variety of road and weather condition during the two-day competition.

SOUTHWEST FOR Good GREASE
MANUFACTURERS
PETROLEUM LUBRICATING GREASES
AND SPECIALTIES
WRITE FOR ILLUSTRATED BOOKLET
SOUTHWEST GREASE & OIL CO.
220-230 W. WATERMAN, WICHITA 2, KANSAS

FISKE BROTHERS
REFINING CO.
Established 1870
★
NEWARK, N. J.
TOLEDO, OHIO
★
Manufacturers of
LUBRICATING
GREASES

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

Foote
MINERAL COMPANY
A Step Ahead in Industrial Ores and Chemicals

"Lithium and Strontium Chemicals for the Petroleum Industry"

Home Office: 18 W. Chelten Ave., Philadelphia 44, Pa.
Plant: Exton, Pa.

LEAD NAPHTHENATE
(liquid & solid)
LEAD OLEATE
ALUMINUM STEARATE
THE HARSHAW CHEMICAL CO.
1945 East 97th Street, Cleveland 6, Ohio
BRANCHES IN PRINCIPAL CITIES

GREASE MAKERS
ALUMINUM STEARATE
PLYMOUTH
No. 801-22
and all other Metallic Soaps
M. W. Parsons,
Imports & Plymouth
Organic Labs., Inc.
59 Beekman St., New York 7, N. Y.

ALEMITE PRODUCTS
FOR
AUTOMOTIVE-INDUSTRIAL-FARM
LUBRICATION
- LUBRICATION FITTINGS AND HAND GUNS
- HANDLING AND TRANSFERRING EQUIPMENT
- POWER OPERATED LUBRICATION EQUIPMENT
- PORTABLE LUBRICATION DEPARTMENTS
- AUTOMATIC LUBRICATION SYSTEMS
- CENTRALIZED LUBRICATION SYSTEMS

ALEMITE
division of
STEWART-WARNER CORP.
CHICAGO

Cottonseed Fatty Acids
Tallow Fatty Acids
Stearic & Oleic Acids
A. GROSS & CO.
295 MADISON AVE.
N. Y. 17
FACTORY:
NEWARK,
N. J.

DARLING'S
STEARIC ACID
OLEIC ACID
RED OIL
FATTY ACIDS
DARLING & COMPANY Manufacturers
4203 South Ashland Avenue • Chicago

ARO
LUBRICATING
EQUIPMENT
Complete lines for Automotive and Industry.
Write for catalogs.
THE ARO EQUIPMENT CORPORATION
Bryan, Ohio

MONSANTO
SANTODEX
gives you dual grading profits

MONSANTO OIL ADDITIVES

SANTOPOUR,* SANTOPOUR B
Pour point depressants.

SANTOLUBE* 395, 395-X, 398, 394-C
Motor oil inhibitors.

SANTODEX*
Viscosity index improver.

SANTOPOID* S, S-R1, 29, 30
Gear lubricant additives to meet requirements of Army specifications 2-105A and 2-105B.

SANTOLUBE 203-A, 303-A, 520
Motor oil detergents.

INHIBITOR-DETERGENT COMBINATIONS
for premium and heavy-duty service.

SANTOLENE* C
Rust inhibitor.

SANTOLUBE 52
Cutting oil additive.

**Reg. U. S. Pat. Off.*

WRITE FOR FREE BULLETIN No. O-48, containing specifications and blending suggestions. MONSANTO CHEMICAL COMPANY, Dept. A, Petroleum Chemicals Department, 1748 South Second St., St. Louis 4, Mo.

MONSANTO
CHEMICALS AND PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

NOW AVAILABLE FOR PACKAGING UNDER YOUR BRAND

**Colloid Process — Lithium Base*

MULTI-PURPOSE LUBRICANT

★

SATISFIED CUSTOMERS
MORE PROFITS

★

One Lubricating Grease for all uses

BALL AND ROLLER BEARINGS
CHASSIS
UNIVERSAL JOINTS
WATER PUMPS
WHEEL BEARINGS

One Lubricating Grease for all year round

WATER REPELLENT
LUBRICATES SUB-ZERO TEMPERATURES
HIGH HEAT RESISTANT
GREATER STABILITY
ECONOMICAL TO USE

**Colloid Process—Jesco's Own new process—finer particles, more particles, because of increased dispersion—greater stability.*

JESCO LUBRICANTS CO.

1437-39 GENTRY
NORTH KANSAS CITY, MISSOURI

GULF

A Complete Line of Quality Oils and Greases

★

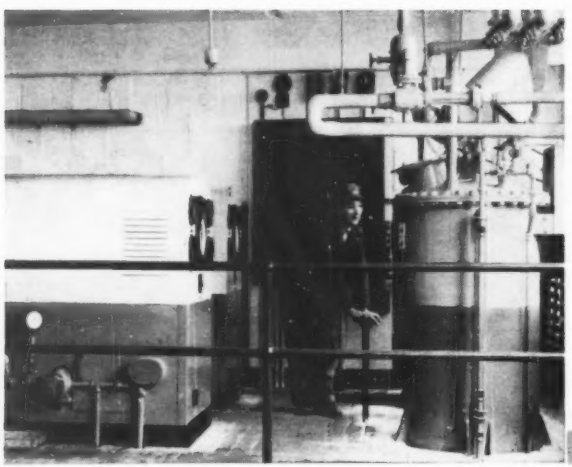
GULF OIL CORPORATION—GULF REFINING COMPANY

DIVISION SALES OFFICES
Boston—New York—Philadelphia
Atlanta—New Orleans—Houston
Toledo

REFINERIES
New York, N. Y.—Philadelphia, Pa.
Pittsburgh, Pa.—Toledo, O.—Cincinnati, O.
Port Arthur, Tex.—Fort Worth, Tex.
Sweetwater, Tex.

Votator
GREASE MAKING APPARATUS

BOOSTS PRODUCT UNIFORMITY



★ Uniformity of product is maintained automatically when VOTATOR Grease Making Apparatus processes aluminum and lithium stearate lubricating grease. That's because VOTATOR apparatus gives precise mechanical control over the entire process . . . the chances for error, ever present with pan methods, are practically eliminated.

VOTATOR equipment makes possible accurate measurement of ingredients. This also helps to assure a uniform product at all times and avoids reworking with resultant loss of man-hours.

Cooking and cooling takes only three minutes with this completely enclosed processing system. Fuel costs are lowered. Write for complete information. The Girdler Corporation, Votator Division, Louisville 1, Kentucky.

DISTRICT OFFICES: 150 Broadway, New York City 7
2612 Russ Bldg., San Francisco 4
22 Marietta Bldg., Rm. 1600, Atlanta Ga.

VOTATOR *is a trade mark applying only to products of The Girdler Corporation*

Producers of

LEAD NAPHTHENATE

MOONEY CHEMICALS, INC.

INDUSTRIAL CHEMICALS

Phone
SUperior 1-8383

2271 SCRANTON ROAD — CLEVELAND 13, OHIO

INTERNATIONAL LUBRICANT CORPORATION

New Orleans, U. S. A.

MANUFACTURERS
OF
QUALITY
LUBRICANTS

AVIATION
INDUSTRIAL
AUTOMOTIVE
MARINE

With Research Comes Quality, With Quality Comes Leadership.

Scientifically

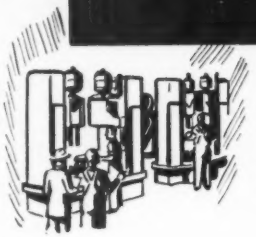
CONTROLLED MANUFACTURING

Every product that is manufactured by the Cato Oil & Grease Company is the final result of exhaustive laboratory tests. Actual manufacturing of all Cato lubricants is scientifically controlled. For that reason, many desirable "extras" are added to even the most highly refined lubricants. Look to Cato for quality lubricants that can be counted on for above-the-average performance.

Top Quality

CATO

LUBRICANTS



Engineered

APPLICATION SERVICE . . .

Cato's engineered application service assures proper application of all lubricants manufactured by the company. Cato engineers are waiting to serve you whenever difficulties arise anxious to assist you in working out difficult lubrication problems.

CATO OIL AND GREASE CO., OKLAHOMA CITY, OKLA., U.S.A. MANUFACTURERS DISTRIBUTORS & EXPORTERS OF LUBRICANTS

AVIATION OILS AND GREASES

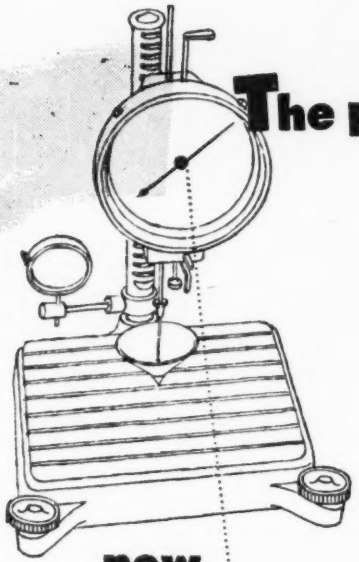
PETRO CHEMICALS AND WAXES

Be *sure* THE PURE OIL COMPANY, U.S.A. PURE **with Pure**

THE PURE OIL COMPANY • 35 EAST WACKER DRIVE, CHICAGO

AUTOMOTIVE OILS AND GREASES

INDUSTRIAL OILS AND GREASES



The penetrometer proves:

new Mallinckrodt®

ALUMINUM STEARATE TECHNICAL D-50

GIVES HIGHEST YIELDS

Ultra-high efficiency D-50 is now ready to go to work for you—making aluminum greases at lower cost than ever before. D-50 greases have high dropping points and unusual resistance to mechanical break-down.

Let us show you how your aluminum stearate greases can be produced more economically by using D-50 alone or in combination with other Mallinckrodt Aluminum Stearates. Our experience has shown that smooth, uniform greases can be made efficiently with properly chosen stearates.

Write today for your copy of our new comprehensive data booklet "Aluminum Soaps for Lubricating Grease Manufacture".

% Aluminum Stearate Required for A. S. T. M. Worked Penetration Value of 300

Aluminum Stearate	0 1 2 3 4 5 6 7 8	S.U.V. at 100° F	Type Oil
D-50 Ordinary		900"	Mid-Continent
D-50 Ordinary		900"	Paraffinic
D-50 Ordinary		500"	Naphthenic

MALLINCKRODT CHEMICAL WORKS

Mallinckrodt St., St. Louis 7, Mo. • 72 Gold St., New York 8, N. Y.

CHICAGO CINCINNATI CLEVELAND LOS ANGELES MONTREAL PHILADELPHIA SAN FRANCISCO

Manufacturers of Medicinal, Photographic, Analytical and Industrial Fine Chemicals

WHAT DO YOU KNOW ABOUT SPERM OIL?

COMPOSITION Sperm Whale Oil is unique among all of the fatty oils. It is actually a liquid wax, being composed of about 65% normal higher monohydric alcohol esters and 35% of the glycerol esters.

COLOR Sperm Oil ranges from a pale yellow to an almost water white.

VISCOSITY Sperm Oil has an unusually flat viscosity index curve. At increased temperatures or pressures, Sperm Oil is affected much less than other fatty oils.

REACTIVITY Sperm Oil combines readily with chemical reagents. When reacted at fairly high temperatures, it bodys very little. Nor will it become gummy as do animal and vegetable oils.

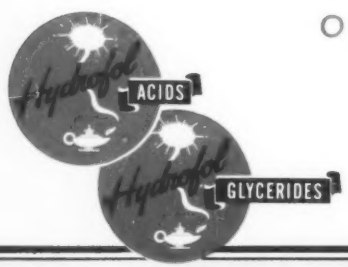
OXIDATION Sperm Oil is non-drying. It will not turn rancid or oxidize under prolonged exposures to the air.

SPECIFIC GRAVITY Sperm Oil's specific gravity is lower than that of the glyceride type oils. About .883 for the Natural oil, and .925 for the bodied.

SOLUBILITY Sperm Oil is miscible with most organic solvents, except alcohol. Alcohol-miscible Sperm Oil can be furnished, however.

As the world's largest producer and refiner of Sperm Whale Oil, we are prepared to ship any amounts... from one pound to a dozen tank-cars. All products are guaranteed to be 100% pure Sperm Oil... the finest quality available.

Sperm Oils	F. F. A. (max)	Sap. No.	Iodine No.	Vis. @ 100° F	% Unsap.	Cloud Pt.	Flash Pt.
45° Natural Winter	2.00	132-138	80-90	100-115	32-35	44-46° F	500-510° F
45° Bleached Winter	0.25	132-138	80-90	100-115	32-35	44-46° F	500-510° F
38° Natural Winter	2.00	132-138	80-90	100-115	32-35	44-46° F	500-510° F
38° Bleached Winter	0.25	132-138	80-90	100-115	32-35	44-46° F	500-510° F
Bodied	8.50	170-180	48-54	290-310	30-35	45-50° F	500-510° F



Other Sperm Oil Products are:

USP SPERMACETI WAX • SPERMAFOL • COSMOL
LIQUID ALCOHOLS • SOLID ALCOHOLS

Samples will be sent on your request

WRITE TODAY FOR MORE DETAILS

THE WERNER G. SMITH CO.

(DIV. ARCHER-DANIELS-MIDLAND-COMPANY)

2191 WEST 110th STREET • CLEVELAND 2, OHIO

for GREASE MAKING:

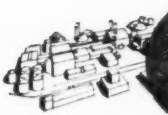
CHECK THESE IMPROVED EMERY FATTY ACIDS!

SPECIFICATION SHEET

DESCRIPTION	DATA
EMERY ANIMAL FATTY ACIDS made to uniform specifications emphasizing increased oxidation stability. Typical greases show minimum oxygen absorption when subjected to Norma Hoffman Bomb test.	Emery 530 Animal Fatty Acid: Titer 40 to 42° C., Iodine Value 55-65, Color (Lovibond) 60Y/20R—5¼" cell, max.
*__EMERSOL ELAINES__ for fatty-base soluble oils and special lubricants are the most stable oleic acids available . . . highest resistance to oxidation . . . maximum color stability . . . lowest unsaponifiable. Emersol 233 LL Elaine, the purest oleic acid available, is also the most stable by any test.	Emery oleic acids are available in titers ranging from below 5 to 11°C. and Lovibond colors as light as 5.0Y/0.5R—5¼" cell. Specifically, Emersol 210 Elaine: Titer 8-11°C., Iodine Value 90-93, Unsaponifiable 2.5 max.
*__EMERSOL STEARIC and PALMITIC ACIDS__—all grades exhibit extremely high stability of color and odor, which means higher quality in finished products. Emersol 140 (70% min. palmitic content) and Emersol 150 (80% min. stearic content) Fatty Acids provide unusual product characteristics.	Regular grades of Emery Stearic Acids range from Emersol 110 (single pressed type) to Emersol 132 Lily (triple pressed type) with an I.V. below 1.0. Typical specifications, Emersol 120 Stearic Acid (double pressed type): Titer 129-130°F., Iodine Value 7.0 max., Color (Lovibond) 2.5Y/1.0R—5¼" cell, max.
HYDROGENATED FISH and TALLOW FATTY ACIDS made from carefully selected stocks, provide higher melting point, lower iodine value fatty acids with a range of compositions.	Emery Hydrogenated fatty acids include Hyfacs 430 and 431 made from fish stocks and 410 and 420 hydrogenated tallows and 450, a special hydrogenated stearic acid. For example, Hyfac 410: Titer 133-140° F., Iodine Value 3-7, Color (Lovibond) 30Y/5.0R—5¼" cell, max.

*Emersol, a patented process designed and engineered by Emery Research.

The World's Largest Producer of Fatty Acids



EMERY INDUSTRIES, INC.

EXPORT DEPT: 3002 E.C.A. BLDG., NEW YORK 38, N. Y.

Branch Offices:
3002 Woolworth Bldg., New York 7, N.Y.
187 Perry St., Lowell, Mass.
401 N. Broad St., Philadelphia 8, Pa.

SYNTHETIC STEARATES

Recently developed and perfected for Lubricating Greases.

SYNTHETIC-100

Extreme Jell Aluminum Stearate

Will jell more oil per pound than any other grade previously available. Used where low cost, high yields are specified. Saves as much as twenty per cent on cost of stearate.

SYNTHETIC-150

High Jell Aluminum Stearate

For clear, brilliant non-grainy greases.
Uniform, laboratory checked production.

•

SAVE WITH SYNTHETIC STEARATES

Send for sample and compare

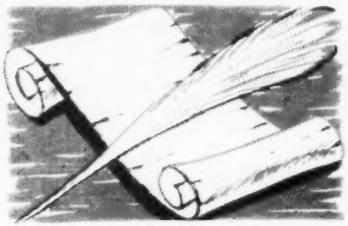
•

SYNTHETIC PRODUCTS CO.

(Established 1917)

1798 LONDON ROAD CLEVELAND 12, OHIO

Associate and Technical Members . . . of the *National Lubricating Grease Institute*



Supporting Your Organization These Suppliers of Your Industry Hold Membership in the N. L. G. I.

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

Armour & Co., Chemical Division
1355 West 31st St.
Chicago 9, Illinois
Member—Dale V. Stingley

American Cyanamid Company
30 Rockefeller Plaza
New York City, New York
Member—A. Scharwachter

Darling & Company
4201 South Ashland Avenue
Chicago 9, Illinois
Member—George W. Trainor

Emery Industries, Inc.
Carew Tower
Cincinnati 2, Ohio
Member—R. F. Brown

Foote Mineral Company
18 W. Chelton Street
Philadelphia 44, Pennsylvania
Member—H. C. Meyer, Jr.

A. Gross & Company
295 Madison Avenue
New York City 17, New York
Member—Eugene Adams

W. C. Hardesty Co., Inc.
41 East 42nd Street
New York City, New York
Member W. G. McLeod

Harshaw Chemical Company
1945 East 97th Street
Cleveland 6, Ohio
Member—G. G. Unkefer

Lubrizol Corporation
Euclid Station
Cleveland 17, Ohio
Member—J. H. Baird

Mallinckrodt Chemical Works
New York 8, New York
St. Louis 7, Missouri
Member—C. E. Cosby

N. I. Malmstrom & Company
147 Lombardy Street
Brooklyn 22, New York
Member—Ivar Wm. Malmstrom

Metasap Chemical Corporation
Harrison, New Jersey
Member—O. E. Lohrke

Monsanto Chemical Company
1700 Second Street
St. Louis 4, Missouri
Member—J. W. Newcombe

National Lead Company
105 York Street
Brooklyn 1, New York
Member—Alexander Stewart

National Rosin Oil Products, Inc.
R.K.O. Bldg., Rockefeller Center
New York City, New York
Member—Richard Bender

M. W. Parsons, Imports & Plymouth Organic Labs., Inc.
59 Beekman Street
New York City 7, New York
Member—H. Bye

Swift & Company, Industrial Oil Division
165th & Indianapolis Blvd.
Hammond, Ind.
Member—F. H. Beneker

Warwick Chemical Company
Division of the Sun Chemical Corporation
10-10 44th Avenue
Long Island City 1, New York
Member—Dr. J. J. Whitfield

The Werner G. Smith Co.
(Division of Archer-Daniels-Midland Co.)
2191 West 110th Street
Cleveland 2, Ohio
Member—F. C. Haas

Witco Chemical Co.
75 E. Wacker Drive
Chicago, Illinois
Member—B. W. Lewis

CONTAINER MANUFACTURERS

Central Can Company, Inc.
2415 West 19th Street
Chicago, Illinois
Member—Henry Frazin

Continental Can Co.
1103 Waldheim Building
Kansas City 6, Missouri
Member—N. M. Potts

Geuder, Paeschke & Frey Co.
324 North Fifteenth Street
Milwaukee 3, Wisconsin
Member—Willard J. Flint

Inland Steel Container Company
6532 South Menard Avenue
Chicago 38, Illinois
Member—J. T. Gossett

J & L Steel Barrel Company
70 East 45th Street
New York City, New York
Member—Jerry Lyons

Rheem Manufacturing Company
570 Lexington Avenue
New York, New York

United States Steel Products Co.
30 Rockefeller Plaza
New York City 20, New York
Member—Wm. I. Hanrahan

Vulcan Stamping & Manufacturing Co.
300 Madison Street
Bellwood, Illinois
Member—Dale M. Harpold

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

The Aro Equipment Corporation
Byron, Ohio
Member—R. W. Morrison

Balcrank, Inc.
Disney near Marburg
Cincinnati 9, Ohio
Member—R. P. Field

Gray Company, Inc.
60 11th Avenue Northeast
Minneapolis 13, Minnesota
Member—L. L. Gray

Lincoln Engineering Company
5730 Natural Bridge Avenue
St. Louis, Missouri
Member—Foster Holmes

National Sales, Inc.
812 North Main Street
Wichita, Kansas

Stewart-Warner Corp.
1826-1852 Diversey Parkway
Chicago, Illinois
Member—Walter Duncan

U. S. Air Compressor Company
5300 Harvard
Cleveland, Ohio
Member—C. A. Benning

LABORATORY EQUIPMENT AND SUPPLIES

Precision Scientific Company
3737 Cortland Street
Chicago 47, Illinois
Member—Alexander I. Newman

SUPPLIERS OF EQUIPMENT FOR MANUFACTURING LUBRICATING GREASES

Buflovak Equipment Division of Blaw-Knox Company
1543 Fillmore Avenue
Buffalo 15, New York
Member—A. W. Johnson

The Girdler Corp.
Louisville 1, Kentucky
Member—John E. Slaughter, Jr.

Stratford Engineering Corporation
1414 Dierks Building
Kansas City, Missouri
Member—J. A. Altshuler

REFINERS

Calumet Refining Company
4323 Southwestern Blvd.
Chicago, Illinois
Member—H. E. Semerau

Farmers Union Central Exchange, Inc.
P. O. Box G
St. Paul 1, Minnesota

Mid-Continent Petroleum Corporation
Tulsa, Oklahoma
Member—T. E. Fitzgerald

TECHNICAL AND RESEARCH ORGANIZATIONS

Cargill, Incorporated
200 Grain Exchange
Minneapolis 15, Minnesota
Member—Dr. Sabine Hirsch

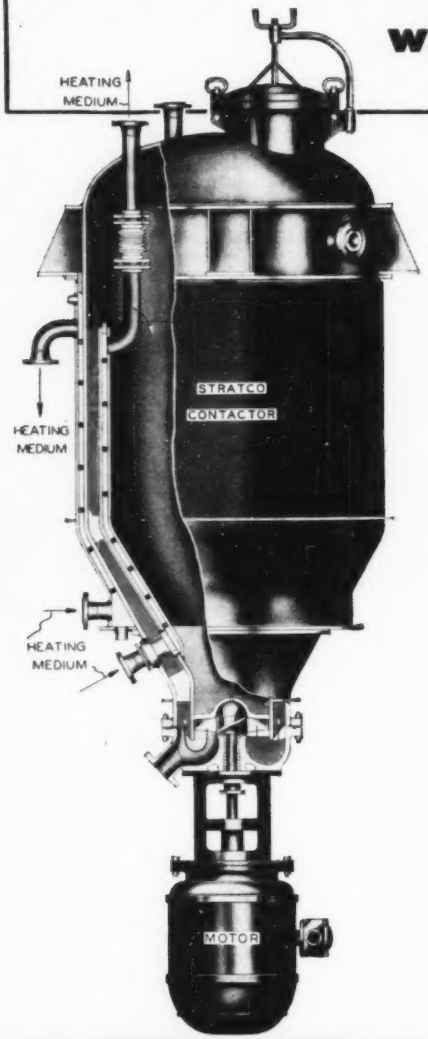
Mellon Institute of Industrial Research
University of Pittsburgh
Pittsburgh 13, Pennsylvania
Member—Malcolm Finlayson

Midwest Research Institute
4049 Pennsylvania
Kansas City 2, Missouri

GREASE MANUFACTURE SIMPLIFIED
Time Saved . . . Cost Reduced

with the

STRATCO



High Dispersion CONTACTOR
and Oil Circulation Heating System

This equipment puts your plant on an eight hour basis, simplifies laboratory control, reduces manpower requirements, produces a more uniform product at lower cost.

The Contactor is also adaptable to any other mixing problem where one or more of the materials to be mixed is a liquid.

STRATFORD ENGINEERING
CORPORATION
PETROLEUM REFINING ENGINEERS

DIERKS BLDG. KANSAS CITY, MO.

VOL. 14
NOS 1-12

1 9 5 0

PUB. 424

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN. 1951